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FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

MATHEMATICS

GCE Ordinary Level

Paper 4024/01

Paper 1

General comments

This proved to be a fair test for candidates, but was perhaps a little more searching for the most able than usual. Even the weakest found much on which they could demonstrate what they knew and could do. Candidates did not seem to have difficulty in finishing the paper in the time allowed. Indeed, many scored well in the last question, where almost everyone gained some credit.

Generally the standard of presentation and explanation was good, but there were candidates and even whole Centres that fell below the standard expected. Examiners are not able to give credit to candidates when it is not clear what is being attempted.

It was noticeable that the standard of basic skills on this paper has slipped recently. Candidates have perhaps come to rely on their calculators too much when asked to divide by 20, as in the first question, without their aid. When deciding the accuracy and form of the required answers, candidates should bear in mind the nature of the quantities involved. Money answers will often be expected correct to the nearest cent, for example.

Once again candidates had difficulty giving explanations for geometric statements. They need to practice this part of the syllabus. Other areas that appear to need some attention include finance (**Question 7**), problems and loci in three dimensions (**Question 19**) and set notations (**Question 20**).

Comments on specific questions

Question 1

This was intended to be a friendly start for the paper. It was well done, but surprisingly many candidates gave 0.605 as the first answer.

Answers: **(a)** 0.65; **(b)** 80%.

Question 2

The manipulation of fractions was well understood and many correct answers were seen. A few discarded the denominators and some others tried to convert to decimals.

Answers: **(a)** $\frac{8}{21}$; **(b)** $\frac{24}{35}$.

Question 3

The first part was reasonably well done, but there were sign errors in some cases.

Only a small number of candidates saw the connection between the two parts of the question, so the majority started again in the second part. Sign errors spoilt some of these attempts, usually leading to a determinant of 6.

Answers: **(a)** $\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$; **(b)** $\frac{1}{2}\begin{pmatrix} 4 & 2 \\ 1 & 1 \end{pmatrix}$.

Question 4

Some candidates were confident in their determination of the bearings. Others did not seem to know what bearings are, leading to strange answers. A few gave answers in another form (such as N12° W).

Answers: **(a)** 348°; **(b)** 218°.

Question 5

There was a reasonably good response to the first part, though the decimal point was sometimes misplaced. Answers were often trancated or left in unsuitable form. In questions like this, answers are expected correct to the nearest cent, so neither 12.3 nor $12\frac{8}{25}$ were accepted.

Too many assumed the time taken in the second part is directly proportional to the number of workers, leading to a very common wrong answer of 6.4 hours.

Answers: **(a)** \$12.32; **(b)** 10 h.

Question 6

(a) Perhaps the form of the question was slightly unusual, but it became clear that this section of the syllabus was not well understood in general. Some quoted the upper bound, or both upper and lower bounds, and others gave 4999 as their answer.

(b) This was a little better, though a few tried to find an area. Common wrong answers were 10 or 22.

Answers: **(a)** 5 000; **(b)** 20 cm.

Question 7

This test of the financial part of the syllabus and the use of tables proved to be searching. In the first part some gave the number of hours Adam worked (37) rather than the number for which he was paid. The second part proved to be a little easier, but many overlooked the fact that all hours worked were to be counted as 2 hours. Thus \$72.50 was a common answer.

Answers: **(a)** 39 hours; **(b)** \$145.

Question 8

This was well answered, with only a few sign errors.

Answer: $\frac{3x+1}{2}$.

Question 9

This question was also usually well answered. A few tried to eliminate y by adding the equations, but more failed to reach the correct answers due to careless arithmetic, such as 95 – 29 = 64.

Answer: $x = 33$, $y = -4$.

Question 10

This question was not well answered. Prime factors were rarely used effectively to find the L.C.M. Some wrote down timetables for the routes, but 35 minute intervals caused difficulties. Although the answer 140 minutes was expected the time 11.20 was accepted on this occasion, as it was far better than 10 + 20 + 35 = 65 minutes, that was all too common.

Answer: 140 minutes.

Question 11

Both parts were quite well done, though many rectangles in the first part had a height of 0.2 and a few a height of 0.4. Feint pencil lines in the given grid were not always clear.

Answers: **(a)** Rectangle of width 200 and height 0.1; **(b)** 72°.

Question 12

The first part was well done, but arithmetic errors leading to 2235 or 2355 were by no means rare. Some quoted the time in another firm, which failed to answer the question set.

The second part was badly done. Candidates were expected to cope with the units of time in some way. $3\frac{2}{3}$ minutes 21.5 seconds as an answer was not acceptable. Those who converted all times to seconds did best. Very few used an assumed mean (4 minutes say). Those who did, found the question quite easy.

Answers: **(a)** 23 35; **(b)** 4 minutes 1.5 seconds.

Question 13

This question was quite well done. There were a few strange lines drawn, but most attempted a line parallel to the given line, and sensible values given for *k*. The most common errors were –12 or +4 or –4.

Answers: **(a)** (5, $\frac{1}{2}$); **(b)(i)** parallel line through (0, –4), **(ii)** 12.

Question 14

Candidates did well on this question, with many scoring full marks. The most common error was in the first part, where the answer 2 x 52 = 104° was often seen. Follow through marks were then available, and often earned.

Answers: **(a)** 128°; **(b)** 26°; **(c)** 64°.

Question 15

A few saw how to use factors to gain all the answers to this question quite easily. The vast majority of the answers were obtained using long multiplication several times with varying accuracy.

Answers: **(a)** 132 and 87; **(b)** 219.

Question 16

(a) Place values were not well understood. The circled digit was likely to be anywhere. Indeed more than one digit sometimes appeared in the ring.

(b) This was well done, though a few left the answer as 0.05 or $\frac{5}{100}$.

(c) Good, though a few failed to complete the question, leaving the answer as 2^2 or $\sqrt[3]{64}$.

Answers: **(a)** Units digit ringed; **(b)** $\frac{1}{20}$; **(c)** 4.

Question 17

All parts were well done, but some gave insufficiently accurate values in the second part. The upper quartile is clearly greater than 79.

Answers: **(a)** 74.4 to 74.7 kg; **(b)** 79.1 to 79.4 kg; **(c)** 23 to 25.

Question 18

Stronger candidates did well on this question, but weaker ones were apt to become lost in a maze or numbers. Many quoted the answer to the first part somewhere. Some left a formula containing R, while others insisted on substituting a value for π. This made the solution longer and harder than intended. The fractions $\frac{1}{3}$ and $\frac{1}{2}$ were sometimes applied to the wrong area.

Answers: **(a)** $\frac{8\pi x}{45}$ cm^2; **(b)** 15°.

Question 19

Very many failed to use Pythagoras to find the height of triangle ABC, but were able to gain credit for the total surface area from their previous answer. Sadly this was often spoilt by adding one or two squares of area 100 cm^2. The three dimensional locus was not well described. Too often only a few points were mentioned, but Examiners were expecting to see reference to the whole plane which contains *B*, *C*, *D* and *E*.

Answers: **(a)** 60 cm^2; **(b)(i)** 480 cm^2, **(ii)** the plane *BCDE*.

Question 20

Although the first part was usually well done, the second part proved to be difficult. Many showed *C* rather than attempting *C*'. The line in the positive direction starting from a ring round the point representing –3 was required. The set notation tested in the last part was clearly not widely understood, though it did enable a few to shine. The majority failed to realise that ordered number pairs were expected.

Answers: **(a)(i)** $-1 < x \leqslant 4$; **(b)** {(1, 3), (1, 5), (3, 5) and (5, 3)}.

Question 21

Although a few thought the transformation was either a shear or a rotation, the majority recognised the enlargement, but the scale factor was often thought to be either 2 or $\frac{1}{2}$.

The vector question was not well done. It would help candidates (and Examiners) if the steps to be taken are clearly shown. For instance $\overrightarrow{AE} = \overrightarrow{AB} + \overrightarrow{BE} = \frac{1}{2}ED + 3\overrightarrow{BC} = \begin{pmatrix} 3 \\ -4 \end{pmatrix} + \begin{pmatrix} 9 \\ 3 \end{pmatrix}$. Part marks can then be awarded when the final answer is wrong.

Answers: **(a)** Enlargement, centre *C*, scale factor –2; **(b)** $\begin{pmatrix} 12 \\ -1 \end{pmatrix}$.

Question 22

This was a popular question which led to a wide range of scores. Most candidates knew the shape of the missing part of $y = \frac{3}{x}$, but some put it in the wrong quadrant. Most candidates could sketch $y = x$, but it sometimes stopped at the origin and a few drew $y = -x$ as well.

Some candidates did not realise that they needed to solve $x = \frac{3}{x}$ in effect, and many gave only one solution, $\sqrt{3}$. Although decimal answers were not expected, reasonable attempts, such as ± 1.7, were accepted.

Answers: **(a)(b)** Lines sketched; **(c)** $+\sqrt{3}$ and $-\sqrt{3}$.

Question 23

This was quite well answered, but a few joined the origin to (30, 20) or even (30, 19). The acceleration was usually correct from their graph lines, and the method for finding the average speed was widely known. Arithmetic errors (especially 270 + 180 = 350) spoilt many answers.

Answers: **(a)** Straight lines from (0, 0) to (30, 18) to (40, 18); **(b)** 0.6 m/s^2; **(c)** 11.25 m/s.

Question 24

The construction was usually well done, but the areas were not always visible. The use of protractors was less good, with many answers of about 70° seen. The semicircle was usually correct and acceptable values for QM common, but a few appeared to measure LM.

The explanation was not well done. Some stated it was because angle *PMQ* is 90°, and many gave rambling explanations with little substance to them. Examiners expected to see a brief reason, such as "angle in a semicircle property".

For the last part it was hoped that (the result of **(c)**) would be divided by 10, but a few used the cosine formula. The answer "cos110°" missed the point of the question.

Answers: **(b)** 108° to 111°; **(c)** 3.2 to 3.5 cm; **(d)(ii)** –0.32 to –0.35.

Question 25

(a) Short reasons were expected but rare. References such as "interior angles of parallel lines" appropriately applied were expected. Some solutions referred vaguely to the angle sum of a quadrilateral. In such cases reference to symmetry was expected and a statement of which quadrilateral was being used. Too often it was stated 60° = $\frac{1}{2}$ of 120°.

(b) Again unjustified statements were common. Measurements form the diagram were not accepted. If the lengths of sides were used, the minimum expected was *KA* = *AD* = *DC* + *CF* = *FE* + *EK*.

Of course the easiest way was to state $\hat{K} = \hat{D} = \hat{F} = 60^\circ$.

(c) Although many found *GB*, a different value was often used in the ratio of the areas. Many did square what they thought was *DF*:*GB*. There were reasonable attempts at the last part in many cases.

Answers: **(c)(i)** 3 m, **(ii)** 4 : 1, **(iii)** $\frac{3}{4}$.

Question 26

This was a high scoring question for almost all of the candidates, with a pleasing number scoring 6 marks.

(a) This was well done, with just a few sign slips.

(b) Most knew what to do, but many spoilt the answers by carelessness. Very many candidates reached $7x - 2 = 12$ but then failed to get the right answer. Too often it led to $7x = 10$ so $x = \frac{10}{7}$, but even when $7x = 14$ appeared, x (= 14 – 7) = 7 followed.

(c) The majority reached the required factors, though a few sign errors were seen, leading to $(2y - 1)(y + 2)$. A few tried to solve some equation however.

Answers: **(a)** $(3t - 2s)(x + 5y)$; **(b)** 2; **(c)** $(2y + 1)(y - 2)$.

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Paper 2

General comments

The paper appeared to be of an appropriate length and standard, perhaps slightly easier than last year's. Within the questions there were opportunities for candidates of all abilities to apply their knowledge of the subject material. Almost all candidates could attempt many of the more straightforward questions and the most testing parts provided good challenges for even the most able candidates.

Inevitably, a small number of candidates misjudged the time and were rushed towards the end, but in the vast majority of cases, time was used wisely and to good advantage. There were relatively few instances where candidates spent too long on parts of questions which were worth only a small number of marks.

Work from many candidates was of a high standard, with concern for organisation and presentation being regularly in evidence. The presentation generally was good, although there are still a few candidates who provide their solutions in double (or even triple) columns, especially in the early questions.

A number of candidates lost marks through premature approximation, usually in the trigonometry questions, giving the values of trigonometry functions to 2 decimal places. Marks were also lost occasionally when candidates failed to read the questions sufficiently carefully; for example in **Question 1** (solving instead of simplifying or factorising), **Question 2** (not giving the answer in centimetres) and **Question 10** (giving only one solution).

Comments on specific questions

Question 1

This proved to be a popular question with most candidates gaining good marks, although relatively few gained all 10.

Many candidates added = 0 to the three expressions in parts **(a)** and **(b)** and lost marks by giving solutions to "their" equations.

(a)(i) There were many correct answers, but there were quite a number of incorrect expansions of $-3(1 - p)$, usually $-3 + p$ or $-3 - 3p$.

(ii) Most candidates got as far as $3q^2 + 6qr - rq - 2r^2$ and gained 1 mark – but many then either left this as their answer, possibly not recognising that qr and rq are 'like' terms, or re-factorised. A few gave $+2r^2$.

(b) Quite a number stopped at $2(9t^2 - 1)$ and others continued to $2(9t - 1)(9t + 1)$ or $2(3t - 1)^2$. A small number lost the 2 and gave $(3t - 1)(3t + 1)$.

(c)(i) This was well answered, although a number gave the answer 6 from $(-2)^2 = -4$.

(ii) Most candidates arrived at $x^2 = 25$, but very many forgot to give -5 as their second solution.

(iii) A good proportion of the candidates lost a mark by not making it clear that the square root sign covered the denominator of their expression. It was strange to see that many of the candidates who had neglected the -5 value in part **(ii)**, nevertheless remembered to write $\pm$ in this part.

Answers: **(a)(i)** $9 - 5p$, **(ii)** $3q^2 + 5qr - 2r^2$; **(b)** $2(3t + 1)(3t - 1)$; **(c)(i)** 30, **(ii)** ± 5, **(iii)** $\sqrt{\frac{y-18}{3}}$.

Question 2

Fairly well answered, although there was inevitably some confusion between the 2 Blends and the 2 Grades of leaves.

(a)(i) This was usually correct; common wrong answers were 375 (from $\frac{3}{2}\times 250$) and $166\frac{2}{3}$ (from $250\times\frac{2}{3}$).

(ii) Some tried to involve the 3:2 ratio from **(i)** but common wrong answers were 11:9 and 9:20. A small number tried to get to the form 1:*n*.

(iii) There was much muddled thinking here with candidates not using the information from the previous parts.

(b) Part **(i)** was well answered, but, predictably, candidates had much more difficulty with **(ii)** and \$7.44 (120% of \$6.20) was a very common answer.

Answers: **(a)(i)** 150 g, **(ii)** 9:11, **(iii)** 48%; **(b)(i)** \$3.60, **(ii)** \$7.75.

Question 3

There were problems throughout this question, with many invalid assumptions made in all three parts.

(a) Most of the errors came from assumptions that either ΔBCF or ΔABE were isosceles.

(b) This proved to be a very difficult question. Most correct solutions came from consideration of the interior angles of the hexagon and recognition that 3*z* + 3 x 105 was involved.

Some used the hexagon's exterior angles and others worked with the pentagon and the fact that 2 of the angles added up to 180° (although this was rarely stated or explained).

Average and weaker candidates had little idea how to proceed and regularly gave answers of 120°, 105° or 123° [from $\frac{1}{5}(720-105)$].

(c) Many candidates ignored the information concerning similar triangles and assumed right angles at *R* and/or *Q*. Of those who did try to use similar triangles a common error in part **(ii)** was to use a result like $\frac{RS}{QS}=\frac{RQ}{PQ}$ giving $\frac{RS}{21}=\frac{14}{18}$ and $RS=16\frac{1}{3}$. After getting *PR* = 12, some candidates tried to work with trigonometry, and although this was possible, it was particularly difficult as it was necessary to chose the obtuse angle in the ambiguous case of the sine rule.

A few were successful working with areas $\frac{\Delta PRQ}{\Delta PSQ}=\frac{\frac{1}{2}PR\times h}{\frac{1}{2}PS\times h}=\frac{14^2}{21^2}$ leading to *PS* = 27.

Answers: **(a)** 69°, 57°, 72°, 15°; **(b)** 135°; **(c)(i)** 12 cm, **(ii)** 15 cm.

Question 4

(a)(i) This was well answered, although a small number of candidates used long methods. There were a few who, after correctly quoting $\cos 55 = \frac{20}{BC}$ continued *BC* = 20 x cos55.

(ii) The majority of candidates recognised that $AB' = AC + CB'$ and that they were being asked to add 20 to their previous answer, but a small number simply found *AB*.

(iii) This part was a little more difficult and the angle $A'CB'$ was not always seen to be 55°. Although slightly longer it was encouraging to see many candidates using areas to find the height.

(b) Very few candidates were able to describe the path that *A* followed correctly. Most gave a description of the rotational transformation, and very many thought that the angle of rotation was 90° or 70° rather than 125°.

(c) A very small number of candidates found the length of an arc. It was very much more common to see attempts to find the straight line distance AA', using the cosine rule.

Answers: **(a)(i)** 34.9 cm, **(ii)** 54.9 cm, **(iii)** 16.4 cm; **(b)** 125° arc of a circle, centre *C*; **(c)** 43.6 cm.

Question 5

(a) There were many candidates who gave correct answers to all three parts. Some gave the mode as 8 and a few confused median and mode or median and mean. Most had the correct idea for the mean, although a small number used a numerator of 15 and/or a denominator of 6 or 15.

(b)(i) Usually correct, although it was disappointing to see a significant number of answers left as $\frac{5}{5}$ and $\frac{0}{5}$.

(ii) This part caused more difficulty and there were quite a number of answers greater than 1. Quite a number of candidates failed to recognise the difference between parts (b) and (c). Some saw the point, but only got as far as $\frac{8}{21}$.

Answers: **(a)(i)** 0, **(ii)** 1, **(iii)** 1.6; **(b)(i)** $\frac{1}{5}$, 1, 0, **(ii)** $\frac{2}{7}$, $\frac{4}{21}$, $\frac{4}{7}$.

Question 6

(a) Almost all candidates successfully followed the instructions to arrive at the correct result.

(b) Many were also successful here, although a significant number misinterpreted what was asked and chose 2 three digit numbers rather than 3 pairs of digits.

(c) A variable response here. Some candidates did not take into account the result given in the stem and the one in **(a)**, giving an answer "they are all the same", which could have been true for their 3 answers in **(b)**.

(d) This part was not well answered, with only the strongest candidates gaining all three marks. The answers *xy* for **(i)** and *xy* – *yx* (= 0) were seen very regularly, candidates failing to see that the number *xy* had value 10*x* + *y*. It was pleasing nevertheless, that some realised that the result was always nine times the difference of the digits and gave the correct answer for **(ii)**, even though they had not given the correct answer for **(i)**.

Answers: **(a)** 36; **(c)** multiples of 9 or the digits add up to nine (or equivalent); **(d)(i)** 10*x* + *y*, **(ii)** 9 (*x* – *y*).

Question 7

(a) Rather surprisingly this was poorly answered – some confused cuboid and cube and gave either 2 (ignoring the 500 altogether) or $\sqrt[3]{500}$ (ignoring the 2), others worked from $2^2 l$ = 500, getting an answer of 125.

(b)(c) Both these parts were well answered with just a few losing marks through misreading the given formulae, $\frac{1}{3}$ becoming $\frac{1}{2}$ or r^3 becoming r^2.

(d) This proved to be the most difficult part of the question. Use of $2\pi r \times 6 = 500$ or $\pi r^2 \times 6 = 500$ were common. Only occasionally did one see evidence of taking an inner volume from an outer volume. Those who did appreciate this and used *r* and *r* + 1.5 almost always produced the correct answer after accurate algebraic manipulation.

(e) There were very many correct answers to this part, although the use of $\frac{2}{3}$ rather than $\frac{2}{5}$ was quite common. As expected a number of candidates simply found $\frac{2}{5}$ of 500.

Answers: **(a)** 15.8 cm; **(b)** 10 cm; **(c)** 4.92 cm; **(d)** 8.09 cm; **(e)** 32 cm^3.

Question 8

Many candidates seemed to have only a partial understanding of how the graphs related to the physical situation. Many could not appreciate the idea of the top of the pole above the surface. Some confused the surface of the sea with the sea bed.

(a) This was usually well answered, although a large minority did not use the scales stated in the question. The curvature of the graph in the region *t* = 0 to *t* = 2 troubled some, sometimes leading to a wrong plot to try to bend the curve the other way.

(b)(i) Many drew a reasonable tangent, although a few were very carelessly drawn, leading to a gradient value outside the very generous acceptable range. Some candidates did not evaluate their gradient as a single decimal number, leaving their answer in the form, e.g. $-\frac{1.2}{2.8}$. The majority recognised that the gradient was negative.

(ii) Only the better candidates were able to explain the meaning of the gradient in the context of the question. Most referred to the 'steepness of the graph' or 'the sloping sea bed'.

(c) Most candidates gained the marks for drawing the straight line, but relatively few understood what was required in the other parts.

Answers: **(b)(i)** –0.5 to –0.3, **(ii)** rate at which the water level is changing (or equivalent); **(c)(i)** 4 m, **(ii)** 75 to 85 cm, **(iv)** 5.7 to 5.9.

Question 9

This was very well answered on the whole, with many candidates gaining 8 or more marks. However, a number assumed that angle *C* was 62° and lost many marks, and quite a few lost marks through premature approximation.

(a)(i) Most used the sine rule correctly to find angle *ADB* first, although a small number started with the incorrect $\frac{\sin 118}{950} = \frac{\sin A\hat{B}D}{600}$ and others tried to use the cosine rule to find *AD* and then the sine rule to find angle *ABD* – possible, but very long and difficult.

(ii) There were many correct applications of the cosine rule. Occasionally there were errors in the formula used and in a few instances the incorrect collection of terms spoiled an otherwise correct solution.

A small number tried to calculate *CD* as 1040 sin 42.

(iii) Most of the successful solutions here came from the direct 1040 sin 42, but quite a number found angle *CDB* by the sine rule and then used $CD\sin C\hat{D}B$. Another group used areas equating $\frac{1}{2}\times 950\times 1040\sin 42$ to $\frac{1}{2}\times 950\times h$.

(b) This was only answered correctly by the better candidates. Many tried to use 1040 or their *CD*, instead of their answer to part **(a)(iii)**.

Answers: **(a)(i)** 28.1°, **(ii)** 718 m, **(iii)** 696 m; **(b)** 35.7°.

Question 10

(a)(b) Candidates often left units in their expression, or gave answers involving *t*. $\frac{25}{2t}$ or $\frac{25}{2x}$ were occasionally seen in **(b)**.

(c) Many candidates omitted this part and of those who did attempt it, a large number had sign errors in their original equation.

(d) Very many candidates went straight to this part of the question and most quoted the formula correctly. A number got –704 instead of 1216 for $b^2 - 4ac$, or divided by 2 instead of 6, but the most common reason for loss of marks was for candidates to ignore the instruction to give both answers correct to 3 decimal places. Some gave their answers to 3 significant figures and others ignored negative value altogether.

(e) Most candidates gained a method mark by recognising that they should substitute their positive value from part **(d)** into their expressions $\frac{20}{x}$ and/or $\frac{25}{x+2}$. However, some did not attempt to give a 'total' time, some confused hours and minutes and many did not attempt to give their answer correct to the nearest minute. A small number said that the total time was the total distance (45) divided by the total speed (3.145 + 5.145) and gave an answer of 5.43 hours.

Answers: **(a)** $\frac{20}{x}$; **(b)** $\frac{25}{x+2}$; **(d)** 3.145 and –8.479; **(e)** 11 h 13 (or 14) min.

Question 11

This was by far the least popular question, although there were some excellent solutions from those candidates who had clearly studied the topic in depth.

(a)(i) This was usually correct, although a common wrong answer was rotation through 180°.

(ii) Many candidates took a lot of time and effort deriving the matrix P, when the phrase 'write down' and the allocation of only 1 mark should have alerted them to the fact that there was a direct method.

(b) Parts **(i)** and **(iii)** were well answered, but in **(ii)** many simply found $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 1 \\ 2 \end{pmatrix}$ and in **(iv)**, although it was fairly common to see attempts at finding QP^{-1}, correct answers were not seen very often.

(c) Many candidates recognised that $\overrightarrow{DC} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ and a number then wrote $\begin{pmatrix} 2 \\ 3 \end{pmatrix} : \begin{pmatrix} 18 \\ h \end{pmatrix}$ as their answer. Relatively few continued as far as the correct 1 : 9 ratio or appreciated the fact that h = 9 x 3.

Answers: **(a)(i)** Reflection in the line $y = -x$, **(ii)** $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$; **(b)(i)** (–1, 3), **(ii)** (2, –1), **(iii)** Rotation of 90° anticlockwise about the origin, **(iv)** $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$; **(c)(i)** 1 : 9, **(ii)** 27.